

UTILITY  
PATENT APPLICATION  
TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. P00,1732

First Named Inventor or Application Identifier

Erich Hell et al,

Express Mail Label No: #

JC525 U.S. PTO  
09/16/00

09/16/00

ADDRESS TO: Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ Specification [Total Pages 18]  
2. ☒ Drawing(s) (35USC 113) [Total Pages 3]  
3. ☒ Declaration and Power of Attorney [Total Pages 2]

- a. ☒ Executed declaration (Original copy)  
b. ☐ Copy from prior application (37CFR 1.63(d))  
(for continuation/divisional with Box 14 completed)

- i. ☐ [Note Box 4 Below]  
DELETION OF INVENTOR(S)  
Signed statement attached deleting  
Inventor(s) named in the prior application,  
see 37 CFR 1.63(d)(2) and 1.33(b).

4. Incorporation By Reference (usable if Box 3b is checked)  
The entire disclosure of the prior application, from which a  
copy of the oath or declaration is supplied under Box 3b,  
is considered as being part of the disclosure of the  
accompanying application and is hereby incorporated by  
reference therein.

ACCOMPANYING APPLICATION PARTS

5. ☒ Assignment Papers (cover sheet & documentation)  
Siemens Aktiengesellschaft  
6. ☐ Letter under 37 CFR 1.41(c).  
7. ☐ English Translation Document (if applicable)  
8. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations  
9. ☐ Preliminary Amendment  
10. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)  
11. ☐ Small Entity Statement filed in prior application, Status still proper and desired  
12. ☒ Certified Copy of Priority Document(s) German  
Application No. 199 45 413.2 filed September 22, 1999  
13. ☐ Other:

14. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) ☐ of prior application No: /

CLAIMS AS FILED

(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) BASIC FEE \$690.00
TOTAL CLAIMS 20	18			
INDEPENDENT CLAIMS 3	2			
ANY MULTIPLE DEPENDENT CLAIMS? (YES (X) NO				
			TOTAL FILING FEE ->	\$690.00

☒ The Commissioner is hereby authorized to charge any additional fees which may be required in connection with this application, or credit any overpayment to ACCOUNT NO. 501-519. A duplicate copy of this sheet is enclosed.

☒ A check in the amount of \$ 690.00 to cover the filing fee is enclosed.

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SIGNATURE: [Signature]

DATE: September 15, 2000

## **SPECIFICATION**

### **TITLE**

#### **COOLING DEVICE AND COMPUTED TOMOGRAPHY APPARATUS EMPLOYING SAME**

### **5 BACKGROUND OF THE INVENTION**

#### **Field of the Invention**

The present invention is directed to a cooling device for an X-ray source arranged at a gantry rotatable around a rotational axis, as well as to a computed tomography apparatus with such a cooling device.

#### **10 Description of the Prior Art**

Approximately 99% of the electrical energy utilized in the generation of X-rays with an X-ray source is converted into thermal energy. The heat arising in the operation of the X-ray source usually must be eliminated from the X-ray source in some manner in order to be able to operate the X-ray source over a longer time span for radiological exposures of a  
15 subject. This is particularly required when high X-ray power is needed as, for example, in computed tomography or angiography.

Added thereto as a complicating factor in computed tomography is that the X-ray source is arranged at a gantry that rotates around a rotational axis during radiological exposures. Whereas electrical energy can be supplied to the X-ray source relatively simply  
20 via wiper rings, the elimination of the heat arising during operation of the X-ray source proves problematical. X-ray sources with a rotating anode X-ray tube that are conventionally

utilized in computer tomography and operate so that the heat arising during operation of the rotating anode X-ray tube is intermediately stored in the anode dish and is transferred – mainly by thermal radiation – to a coolant and insulating oil that surrounds the rotating anode X-ray tube and is contained in a housing of the X-ray radiator. The coolant and insulating oil usually circulates in a closed circulation loop through the housing of the X-ray radiator and a first heat exchanger that co-rotates with the gantry that emits the heat to the air surrounding the gantry. A second heat exchanger, that is stationary relative to the gantry, cools the heated air around the gantry and transfers the heat absorbed from the air to, for example, a stationary cooling water system.

A disadvantage of such an arrangement for cooling the rotating anode X-ray tube is that the majority of the heat transmission from the first heat exchanger to the air surrounding the gantry as well as the majority of the heat transmission from the air to the second heat exchanger takes place in a significantly locally limited manner, i.e. only to the environment of the respective locations of the X-ray source or the first heat exchanger, so that the effective area for the heat exchange is relatively small.

## SUMMARY OF THE INVENTION

An object of the present invention is to implement a cooling arrangement of the type initially described wherein the elimination of heat generated during operation by an X-ray source arranged at a gantry is improved. A further object of the invention is to provide a

computed tomography apparatus having an X-ray source wherein the heat generated during operation by the X-ray source arranged at a gantry is eliminated in an improved manner.

This object is inventively achieved by a cooling arrangement for an X-ray source arranged at a gantry that is rotatable around a rotational axis, the cooling arrangement having  
5 a ring-like heat exchanger that is arranged at the gantry and is connected to the X-ray source in thermally conductive fashion. The ring-like fashioning of the heat exchanger, i.e. the fashioning thereof adapted to the preferred form of the gantry, enables a large-area heat transfer of the heat arising when generating X-rays with the X-ray source from the heat exchanger to the air surrounding the heat exchanger in a simple way, with heat transfer occurring over the entire circumferential surface of the ring-like heat exchanger. Although  
10 the heat transfer from the X-ray source to the heat exchanger is still relatively locally limited, the area for the heat transfer from the heat exchanger to the air surrounding the heat exchanger is enlarged so that the elimination of the heat is significantly improved. Whereas the area for the heat exchange for current, standard heat exchangers provided at the gantry amounts to approximately  $0.1 \text{ m}^2$ , three times the area for the heat exchange is already  
15 obtained with the inventive ring-like, heat exchanger adapted to the size of the gantry that has a radius of approximately 0.5 m and a width of approximately 0.1 m. The heat exchanger is preferably arranged ring-like around the gantry, however, the heat exchanger alternatively can be arranged axially offset relative to the gantry in the direction of the rotational axis and  
20 preferably with substantially the same radius as the gantry.

In a preferred embodiment of the invention the heat exchanger is rotatable around the rotational axis together with the gantry. The heat transfer from the X-ray source to the first heat exchanger therefore can be accomplished in a simple way by thermal conduction since no parts of the gantry and the heat exchanger that move relative to one another and form heat barriers are present.

In a version of the invention the heat exchanger is formed of at least one heat exchange element, or at least two heat exchange elements that are arranged annularly and are connected to one another and to the X-ray source in thermally conductive fashion. This version thus allows the use of individual heat exchange elements that are commercially obtainable and thus economical, of the type, for example, employed in the automotive industry. When arranged ring-like and connected to one another, these heat exchange elements, which are usually cuboid, result in a heat exchanger which effectively eliminates the heat generated during operation of the X-ray source from the X-ray source to the heat exchanger.

A more uniform distribution of the heat generated by the X-ray source and absorbed by the heat exchanger is achieved in a version of the invention wherein a medium flows through the heat exchanger in a closed circulation loop. The medium preferably flows not only through the heat exchange elements connected to one another by, for example, conduits but also flows through cooling and insulating oil that surrounds the X-ray source. This results in a relatively uniform distribution of the heat over the heat exchanger, and thus a large-area

heat transfer from the heat exchanger to the air surrounding the heat exchanger. For example, the cooling and insulating oil also can be employed as the flowing medium.

In another version of the invention coverings extending between the heat exchange elements in the circumferential direction connect the heat exchange elements to one another, and/or annular guide devices at both sides of the heat exchanger are provided. These coverings and/or guide elements conduct an air stream produced by rotation of the heat exchanger, and heated at the heat exchanger, toward the exterior away from the gantry. In this way, heated air is prevented from proceeding into the interior of the gantry which could negatively influence the functioning of the radiation detector (usually arranged at the gantry) and its appertaining electronics.

In another preferred embodiment of the invention, the aforementioned heat exchanger serves as first heat exchanger, and a second heat exchanger is provided that interacts with the first heat exchanger, resulting in the elimination of the heat generated by the X-ray source being further improved. In a version of this embodiment, the second heat exchanger is stationary relative to the first heat exchanger, and the second heat exchanger is either annularly arranged around the first heat exchanger or is attached to the first heat exchanger axially offset in the direction of the rotational axis. In all instances, the two heat exchangers preferably reside extremely closely opposite one another, separated only by an air gap, so that – due to this arrangement – the second heat exchanger is charged with only a comparatively slight, secondary stream of air that has not been heated at the first heat exchanger. As a result, a higher temperature difference between the primary side and the secondary side (i.e.

the side absorbing the heat and the side emitting the heat, for example to the air surrounding the second heat exchanger), that is directly proportional to the cooling power is effective at the second heat exchanger.

In another embodiment of the invention, the second heat exchanger also can be formed of one or more heat exchange elements connected to one another, or a medium can flow through the second heat exchanger. Commercially obtainable heat exchange elements also can be employed to form the second heat exchanger to lower the manufacturing costs. The connection of the heat exchange elements to one another and having a medium flow through the heat exchange elements produce an optimally uniform distribution of the heat over the second heat exchanger – as in the case of the first heat exchanger – and thus resulting in a large-area heat transfer from the second heat exchanger to, for example the air surrounding the second heat exchanger.

In another version of the invention, the second heat exchanger also has coverings extending between the heat exchange elements thereof in the circumferential direction that connect the heat exchange elements to one another. The first and second heat exchangers can have inter-engaging, annular guide devices that guide an air stream generated as a result of the rotation of the first heat exchanger, and heated at the first heat exchanger, to the second heat exchanger. The coverings between the heat exchange elements of the second heat exchanger prevent penetration of non-heated air into the air gap between the first and second heat exchangers. Additionally, the inter-engaging, annular guide devices cause the air heated at the first heat exchanger to be guided in the direction of the second heat exchanger so that this

heated air cannot undesirably proceed into the inside of the gantry and negatively influence the functioning of the radiation detector and its appertaining electronics.

### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an inventive cooling device with first and second ring-like heat exchangers.

Figure 2 is a view of the inventive cooling device in the direction of the arrow II from Figure 1.

Figures 3 and 4 respectively show arrangements of the first and second heat exchangers relative to one another and relative to the gantry.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is a schematic illustration of an inventive cooling arrangement for an X-ray source 2 arranged at an annular gantry 1. In the exemplary embodiment, the gantry 1 is part of a computed tomography apparatus and is seated therein so as to be rotatable in the direction of the arrow 'a' around a rotational axis 3 is perpendicular to the plane of the drawing.

An X-ray radiator 4 that contains the aforementioned X-ray source 2, which can be a rotating bulb tube, and a detector 5 are arranged opposite one another. During operation of the computed tomography apparatus, the gantry 1 rotates around the rotational axis 3, and a fan-shaped X-ray beam 6 emanating from the X-ray source 2 penetrates a measuring field 7



and is incident on the X-ray detector 5. Output signals from the X-ray detector 5 are supplied to a computer 25 which reconstructs an image of a subject (not shown) in the measuring field 7 in a known manner. The electrical connections of the X-ray source 2 and the detector 5 are accomplished via wiper rings in a known way that is not shown. The housing 8 of the X-ray radiator 4 containing the X-ray source 2 is filled (in a way not shown in detail) with cooling and insulating oil in order to cool the rotating bulb tube during operation of the computed tomography apparatus.

In the exemplary embodiment, a first heat exchanger 9, that is fashioned ring-like and is rotatable around the rotational axis 3 together with the gantry 1, is arranged around the gantry 1. In the exemplary embodiment, the heat exchanger 9 is formed of seven annularly arranged heat exchange elements 10 that are filled with a cooling medium and that are connected to one another via hose conduits 11. Such a hose conduit 11 is also conducted through the housing 8, and thus the cooling and insulating oil of the X-radiator 4 as well, in a helical course, for example. A circulating pump 12 schematically indicated in one of the heat exchange elements 10 produces a circulation of the medium through the heat exchange elements 10 and the X-ray radiator 4.

In the exemplary embodiment, a second heat exchanger 13 that interacts with the first heat exchanger 9 and that is likewise fashioned ring-like is arranged around the first heat exchanger 9. The heat exchanger 13 is stationary relative to the heat exchanger 9. An air gap 21 is present between the two heat exchangers 9 and 13. Like the heat exchanger 9, the heat exchanger 13 in the exemplary embodiment also is formed of seven annularly arranged heat

exchange elements 14 in which a medium flows, that are connected to one another via hose conduits 15, so that the medium can circulate through the heat exchange elements 14.

In the exemplary embodiment, the medium is additionally conducted via a cooling system 16 that actively cools the medium and contains a circulating pump (not shown) that accomplishes the circulation of the medium through the heat exchange elements 14 and the cooling system 16.

During operation of the computed tomography apparatus, the medium of the heat exchanger 9 absorbs heat from the cooling and insulating oil when it flows through the X-ray radiator 4, and, as a consequence of the circulation of the medium through the heat exchange elements 10, achieves a relatively uniform distribution of the heat over the first heat exchanger 9. In this way, heat transfer from the first heat exchanger 9 to the air that surrounds the heat exchanger 9 and is present in the air gap 21 between the heat exchanger 9 and the heat exchanger 13, ensues in large-area fashion over the entire circumference of the heat exchanger 9. As a result, the elimination of the heat from the rotating bulb tube forming the X-ray source 2 is noticeably improved.

As a result of the rotation of the heat exchanger 9 with the gantry 1, the air heated by the heat exchanger 9 likewise circulates and charges the primary side of the heat exchanger 13 facing toward the heat exchanger 9 that absorbs the heat from the air circulating in the air gap 21. As a result, medium of the heat exchanger 13 flowing through the heat exchange elements 14 is elevated in temperature. The elimination of the heat picked up by the heat

exchanger 13 ensues to the air surrounding the heat exchanger 13 and also ensues to the cooling system 16 as a result of the circulation of the medium.

Respective coverings 17 or 18 are provided between the heat exchange elements 10 of the first heat exchanger 9 as well as between the heat exchange elements 14 of the second heat exchanger 13. The coverings 17 prevent heated air from proceeding from the air gap 21 into the inside of the gantry 1, which could cause malfunctioning of the detector 5 as well as its appertaining electronics (not shown in detail). The coverings 18, in contrast, mainly serve to prevent secondary streams of non-heated air from proceeding into the air gap 21 between the heat exchangers 9 and 13. In this way, the temperature difference between primary and secondary sides, i.e. the side of the heat absorption and the side of the heat emission, remains higher, this being directly proportional to the cooling power.

Figure 2 is a view of the cooling arrangement in the direction of the arrow II from Figure 1. Figure 2 shows a cross-section through two heat exchange elements 10, 14 of the heat exchangers 9 and 13. As can be seen better in Figure 2 compared to Figure 1, each of the first heat exchanger 9 and the second heat exchanger 13 has two annular guide devices 23, 24 and 19, 20, respectively that are arranged at both sides of the heat exchange elements 10 and 14, respectively, and engage into one another. The guide devices prevent the air that is heated as a result of the rotation of the heat exchanger 9 and that circulates in the air gap 21 from proceeding into the inside of the gantry 1 and guide therein from the gantry 1 in the direction toward the second heat exchanger 13. Moreover, the guide devices prevent the penetration of secondary air into the air gap 21. Figure 2 also shows a device 22 – that cannot be clearly

seen in Figure 1 – for the air that is heated at the heat exchanger 13 and which surrounds the heat exchanger 13 and that is eliminated in the direction of the arrow 'b'.

In the exemplary embodiment, a second heat exchanger 13 for the elimination of the heat generated during the operation of the X-ray source 2 is provided in addition to the first heat exchanger 9, however, the inventive cooling arrangement need not necessarily include the second heat exchanger 13. If the second heat exchanger 13 is omitted, the first heat exchanger 9 emits the heat absorbed from the X-ray source 2 to the surrounding air during operation of the computed tomography apparatus case. Such an embodiment of a computed tomography apparatus is suitable, for example, for investigating materials in factories wherein high demands as to hygiene are not made.

The above-described embodiment of the heat exchangers 9 and 13 respectively with seven heat exchange elements 10, 14 is only an example. The heat exchanger 9 as well as the heat exchanger 13 can be composed of only a single, annularly closed heat exchange element, of a few or of a multitude of annularly arranged heat exchange elements that, as in the case of the present exemplary embodiment, are fashioned cuboid. The number of heat exchange elements is preferably adapted to the required cooling capacity.

Further, it is not necessarily required that for a medium to flow through the heat exchange elements. The heat exchange elements can merely be connected to one another in thermally conductive fashion, for example via copper conduits. For example, the coverings 17 or 18 of the heat exchangers 9 and 13 can serve as such copper conduits.

In the case of the heat exchanger 9, the medium flowing through the heat exchangers can, for example, be the cooling and insulating oil of the X-ray radiator 4, so that no additional medium that distributes heat over the heat exchanger is required beyond the cooling and insulating oil.

5 The first heat exchanger 9, moreover, need not necessarily rotate together with the gantry 1 but can be stationary relative to the gantry 1. In this case, the heat transmission from the X-ray source 2 or the X-radiator 4 to the first heat exchanger 9 ensues, for example, via the air that is present between the X-ray radiator 4 and the first heat exchanger 9 and that is heated at the X-ray radiator 4 and that serves as thermally conductive medium.

10 In the exemplary embodiment, the heat exchanger 9 is arranged around the gantry 1 and the heat exchanger 13 is arranged around the heat exchanger 9. Alternative arrangements of heat exchangers relative to one another and relative to the gantry 1 are shown in Figures 3 and 4.

15 In Figure 3, a heat exchanger 9.1 is arranged axially offset in the direction of the rotational axis 3 relative to the gantry 1 and a heat exchanger 13.1 is arranged axially offset in the direction of the rotational axis 3 relative to the heat exchanger 9.1.

Figure 4 shows an arrangement of a heat exchanger 9.2 offset axially in the direction of the rotational axis 3 relative to the gantry 1, a heat exchanger 13.2 being arranged around said heat exchanger 9.2.

The advantages of the invention are also effective in such modified arrangements of heat exchangers relative to one another as well as relative to the gantry 1, resulting in an improved elimination of the heat generated during operation of the X-ray source 2.

Although other modifications and changes may be suggested by those skilled in the art, it is the intention of the inventor to embody within the patent warranted hereon all changes and modifications as reasonably and properly come within the scope of their contribution to the art.

5

**We Claim As Our Invention:**

1. In an X-ray examination arrangement having an X-ray source mounted at a gantry  
2 which is rotatable around a rotatable axis, the improvement of a cooling arrangement for said  
X-ray source comprising:

4 a ring-like heat exchanger disposed at said gantry and in thermally conductive  
connection with said X-ray source.

2 A cooling arrangement as claimed in claim 1, wherein said heat exchanger is  
rotatable around said rotational axis together with said gantry.

4 3. The improvement of claim 1, wherein said heat exchanger comprises at least one  
heat exchange element.

2 4. The improvement of claim 1, wherein said heat exchanger has a flow path therein,  
and further comprising a heat transfer medium flowing through said heat exchanger in said  
flow path.

2 5. The improvement of claim 1, wherein said heat exchanger comprises at least two  
heat exchange elements thermally conductively connected to each other, and at least one of  
said heat exchange elements being thermally conductively connected to said X-ray source.

6. The improvement of claim 5, further comprising a circumferential covering  
disposed between said at least two heat exchange elements.

7. The improvement of claim 1, wherein said heat exchanger is rotatable around said  
rotational axis together with said gantry, and further comprising a plurality of annular guide  
devices disposed at said heat exchanger and conducting an airstream, generated by rotation of  
said heat exchanger and heated at said heat exchanger, away from said gantry toward an  
exterior of said gantry.

8. The improvement of claim 1, wherein said heat exchanger is a first heat exchanger,  
and further comprising a second heat exchanger disposed in a thermally conductive path with  
said first heat exchanger, with said first heat exchanger transferring heat from said X-ray  
source to said second heat exchanger.

9. The improvement of claim 8, wherein said second heat exchanger is stationary  
relative to said first heat exchanger.

10. The improvement of claim 8, wherein said second heat exchanger is annularly  
disposed around said first heat exchanger.



11. The improvement of claim 8, wherein said second heat exchanger is disposed  
2 axially offset, along said rotational axis, from said first heat exchanger and is attached to said  
first heat exchanger.

12. The improvement of claim 8, wherein said second heat exchanger comprises at  
2 least one heat exchange element.

13. The improvement of claim 8, wherein said second heat exchanger comprises at  
2 least two annular heat exchange elements that are thermally conductively connected to each  
other.

14. The improvement of claim 13, further comprising circumferential coverings  
2 disposed between said at least two heat exchange elements of said second heat exchanger.

15. The improvement of claim 8, wherein said second heat exchanger has a flow path  
2 therein, and further comprising a heat transfer medium flowing through said second heat  
exchanger in said flow path.

16. The improvement of claim 8, wherein said first heat exchanger is rotatable around  
2 said rotational axis together with said gantry, and further comprising a plurality of inter-  
engaging annular guide devices for guiding an airstream, generated by rotation of said first

4 heat exchanger and heated at said first heat exchanger, from said first heat exchanger to said  
second heat exchanger.

17. A computed tomography apparatus comprising:

2 a gantry rotatable around a rotational axis;

an X-ray source and an X-ray detector mounted opposite to each other on said gantry,

4 said X-ray source emitting heat during operation thereof; and

a ring-like heat exchanger disposed at said gantry and thermally conductively

connected to said X-ray source for transferring said heat from said X-ray source.

18. A computed tomography apparatus as claimed in claim 17, wherein said heat

exchanger is a first heat exchanger, and further comprising a second heat exchanger disposed

in a thermally conductive path relative to said first heat exchanger for transferring heat from

said first heat exchanger to an exterior of said gantry.

**ABSTRACT OF THE DISCLOSURE**

A cooling device for an X-ray source arranged at a gantry rotatable around a rotational axis has a ring-like heat exchanger that is arranged at the gantry and is thermally conductively connected to the X-ray source. The cooling device is useable in a computed tomography apparatus having the X-ray source.

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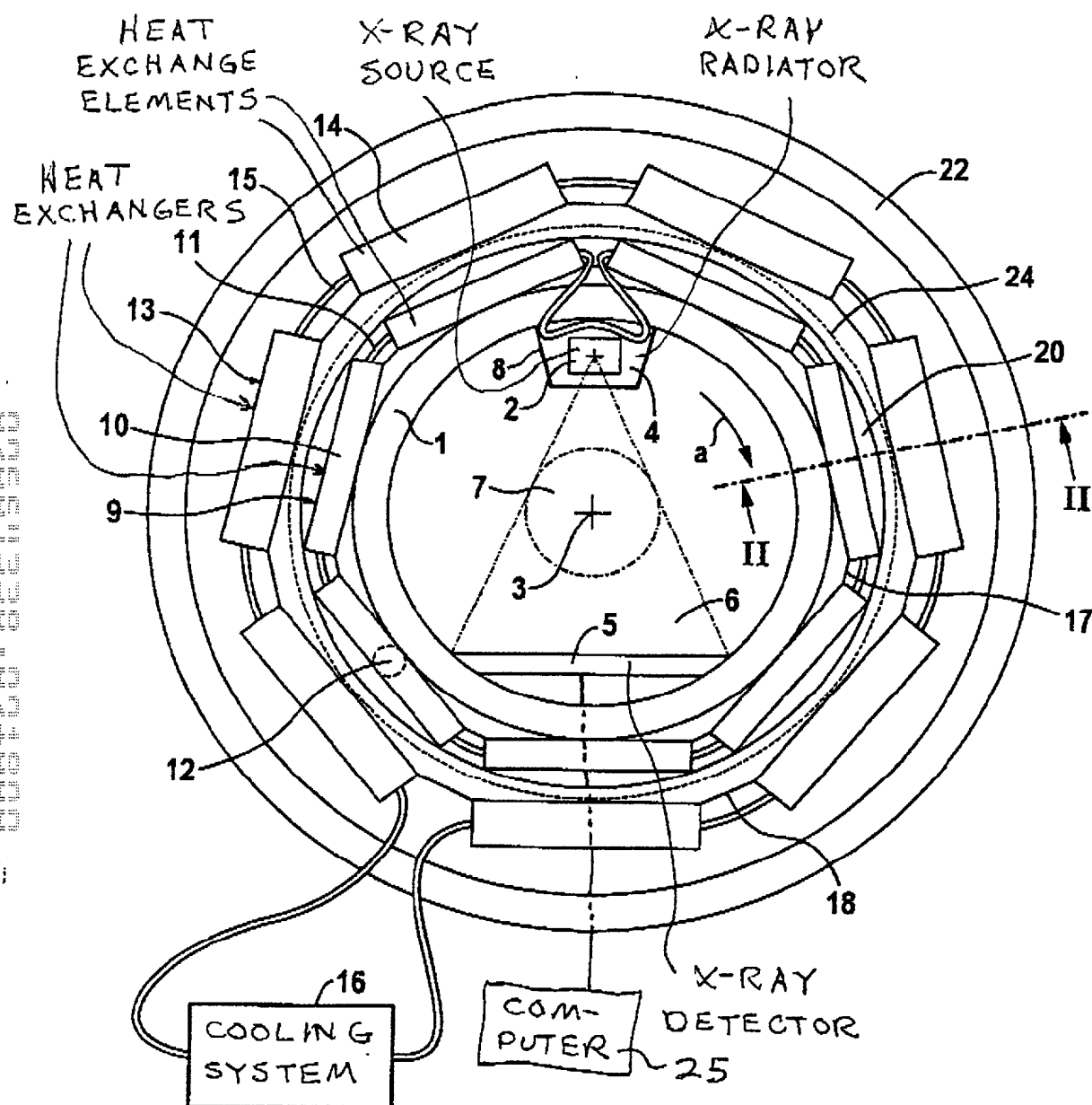
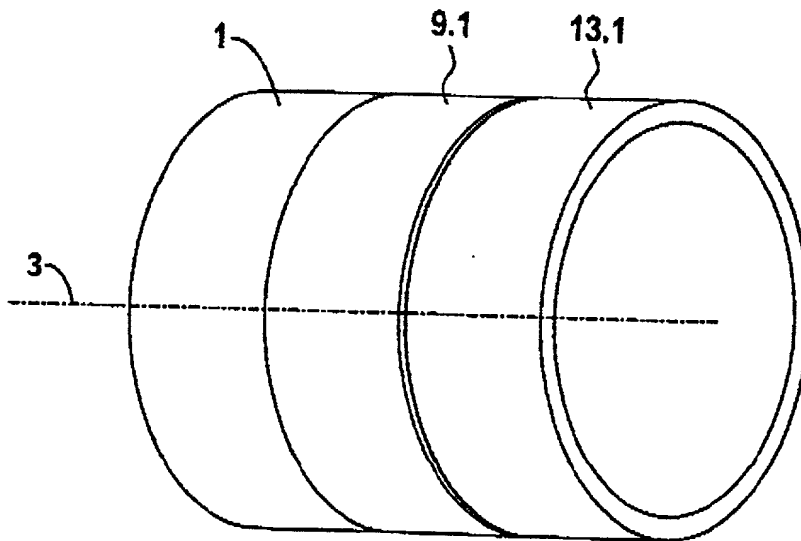
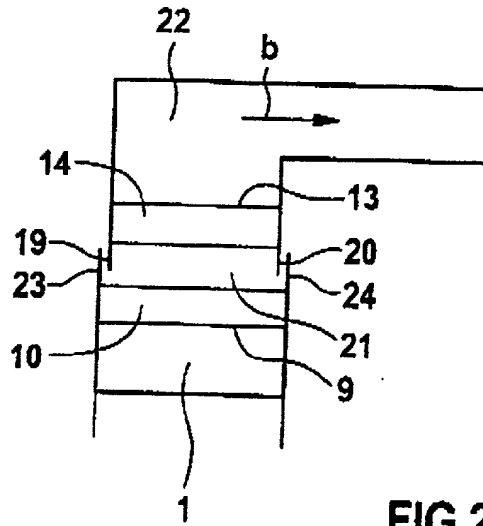


FIG 1

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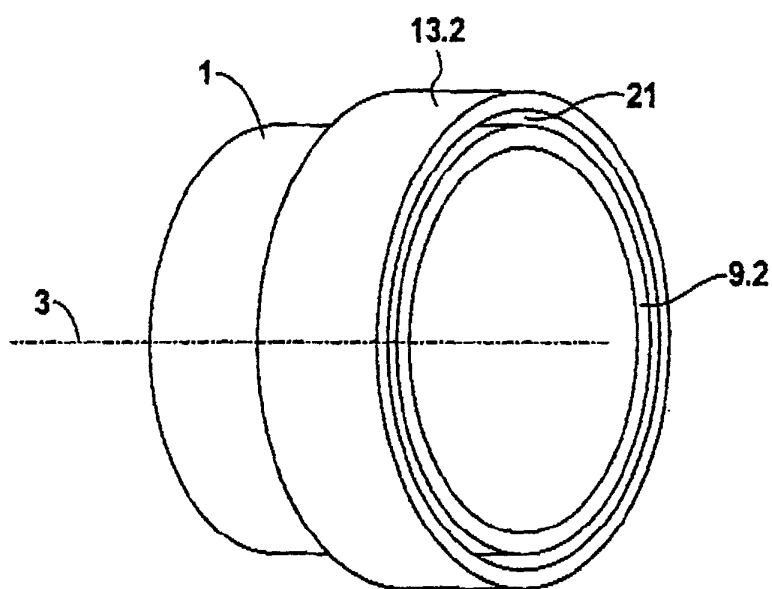


FIG 4

## DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**COOLING DEVICE AND COMPUTED TOMOGRAPHY  
APPARATUS EMPLOYING SAME**

Case No. P00,1732, the specification of which

(check one) X is attached hereto.  
— was filed on \_\_\_\_\_, as  
 Application Serial No. \_\_\_\_\_  
 and was amended on \_\_\_\_\_  
 (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, 1.56.<sup>1</sup>

I do not know and do not believe this invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and I believe that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as identified below:

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below

Prior Foreign Application(s)

Number	Country	Date
19945413.2	Germany	September 22, 1999

and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the above listed application on which priority is claimed:

Prior Foreign Application(s)

Number	Country	Date
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<sup>1</sup> (b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

- (1) It establishes, by itself or in combination with other information, a *prima facie* case of unpatentability of a claim; or
- (2) It refutes, or is inconsistent with, a position the applicant takes in:
  - (i) Opposing an argument of unpatentability relied on by the Office, or
  - (ii) Asserting an argument of patentability.

A *prima facie* case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

If no priority is claimed, I have identified all foreign patent applications filed prior to this application:

Prior Foreign Application(s)

Number

Country

Date

And I hereby appoint Messrs. John D. Simpson (Registration No. 19,842), Steven H. Noll (28,982), Brett A. Valiquet (27,841), James D. Hobart (24,149), Melvin A. Robinson (31,870), and Mark Bergner (45,877) all members of the firm of Schiff, Hardin & Waite, Patent Department,

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my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and direct that all correspondence be forwarded to:

Schiff, Hardin & Waite

Atten: Patent Department

6600 Sears Tower, Chicago, Illinois 60606 -6473

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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